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ABSTRACT

Man's knowledge may be conceptualized and ordered into four domains or classes--formal knowledge, descriptive knowledge, prescriptive knowledge, and praxiological knowledge. In today's rapidly changing world of work, the key saleable skills are flexibility and adaptability. A secondary school program based entirely on the formal, descriptive, and prescriptive disciplines will not provide the necessary knowledges and skills for entry into the labor market. On the other hand, a school program geared to isolated occupational practices which may be obsolete within a few years will not meet the demand. A school program which provides a study of the fundamental principles of practice (praxiology) together with selected practice and a hard theoretical base may meet the challenge of the future. Attempts must be made to determine the basic and significant knowledge of man's practices, and this knowledge must be structured to permit effective and efficient tramsmissions to pupils at the school level. (JS)

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STRUCTURING THE KNOWLEDGE OF MAN'S PRACTICES

presented by

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for the staff of the

Industrial Arts Curriculum Project
(IACP)

Symposium Paper

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SYMPOSIUM: INCREASING LEARNER ADAPTABILITY AND FLEXIBILITY: A STRATEGY FOR STRUCTURING VOCATIONAL EDUCATION CURRICULA. — THURSDAY, February 17 10:10 to 12:00 a.m.

CHAIRMAN: Robert E. Taylor, Director, The Center for Vocational and Technical Education, The Ohio State University

PARTICIPANTS:

The Changing Character of the World of Work and Some Implications for Vocational Education Curricula
Curtis C. Aller, Director, Office of Manpower, Automation, and Training, U.S. Department of Labor, Washington, D.C.

Generalizable Vocational Skills and Knowledge
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Structuring the Knowledge of Man's Practices
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Curriculum Theory and Development in Vocational Education
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DISCUSSANTS: Rupert N. Evans, University of Illinois
Gordon I. Swanson, University of Minnesota

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The rationale presented in this paper has grown out of the deliberations and study of the staff and consultants associated with the Industrial Arts Curriculum Project. Ideas developed in the paper are the products of group effort.

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Headquarters of the IACP are located at The Ohio State University, 980 Kinnear Road, Columbus, Ohio 43212. Inquiries regarding project activities should be forwarded to the project director.

INTRODUCTION

In the search for more significant and meaningful learning experiences for pupils, many professionals concerned with curriculum have focused, within the past few years, upon knowledge and its structure. This emphasis does not necessarily imply that the learner, the teaching-learning process, or the needs of society have been abandoned as major referents. All four elements of curriculum design, i.e., purpose, content, learner, and process must be taken into account in planning an effective educational program. Therefore let it be recognized at the outset that although this paper concentrates upon man's knowledge, per se, the other elements are important and must be carefully considered in curriculum design.

Any body of knowledge must be carefully structured to lead to the understanding of the fundamental "big ideas" of the subject matter. Pupil experiences must be designed to provide maximum reinforcement of the major concepts and skills. Such an educational program should increase learner adaptability and flexibility. This paper will concentrate upon the topic of content structure as it relates to one significant domain of man's knowledge.

The concept of "structure" is not new, although it has been popularized within recent years. Aristotle and Compte were great systematizers of knowledge. Herbart's expression of "systematization" represented the grouping or clustering of concepts and facts (of content) as one phase of method.

The knowledge explosion has helped us realize that we can no longer develop curricula by simple addition of new facts, principles, and skills. In general terms, structure implies the ordering of bits and pieces into meaningful wholes. Structure suggests careful ordering of specifics and relating them to generalizations. This ordering of "particulars" into "classes" has great implications for transfer of learning. By carefully delineating the "elements" within the "context," and by conceptualizing themes that organize and unify, curriculum workers will more adequately structure knowledge, design curricula, and prepare teaching-learning materials which provide pupils with greater understanding of knowledge and skills.

ATTEMPTS AT ORDERING KNOWLEDGE AND SKILLS OF THE WORLD OF WORK

Traditionally, vocational education has used the trade and job analysis technique in identifying the skills and knowledges necessary for successful performance of a specific trade or occupation. This especially has been the case in trade and industrial education; however, broader approaches have been used in other vocational areas. Examples of such trade or occupational areas are pattern-maker, welder, machinist, typist, tailor, and baker. New skills and knowledges are constantly appearing on the work scene. Together with the prospect of occupational groups becoming obsolete with advancing technology, and the necessity of retraining for workers with narrow preparation,

alternatives for trade and job analysis of narrow occupational categories are being considered.

One general approach to broadening vocational training has been to organize instruction around an analysis of skills and knowledges of a family or a cluster of occupations. Such training would not provide in-depth preparation in one narrow task area but would prepare the learner to enter into a family of related occupations.

The American Institutes for Research and the City of Quincy, Massachusetts, are currently engaged in a cooperative study to ascertain the usefulness of the job families approach. Known as Project ABLE, pupils will receive training in several jobs within a job family; and such training will be increased in both breadth and depth the longer the learner remains in school. Individualized instruction and multiple exits from the sequence are features of this program. The eleven job families being developed are: 1) electro-electronics, 2) metals and machines, 3) power mechanics, 4) general woodworking, 5) general piping, 6) foods preparation, 7) computer data processing, 8) health occupations, 9) graphic and commercial arts, 10) home economics, and 11) business education (Altman, 1965, p. 3).

A project with similar ultimate goals at the University of Maryland is attempting to develop the "cluster" concept of occupations to provide the learner with greater occupational mobility upon completion of training. In a brochure recently distributed, the principal investigator

listed examples of occupational groups or families that might be included in such a projected program: 1) medical and health, 2) home facilities, 3) construction, 4) machining, 5) electricity and electronics, 6) communications, and 7) transportation (Maley, 1965, p. 2).

Recently in Illinois a study was completed that identified common or core learnings in six areas of technical education. The following statements appeared in the preface to the report:

> In the area of vocational and technical education, the need to develop instructional programs for occupations which fall within clusters--in the sense that the skills and knowledges required in one occupation relate in some way to the competencies required in another occupation within the cluster--has long been recognized. . . .Instructional programs based upon the recognition and acceptance of commonalities within a family or cluster of occupations should lead not only to increased efficiency in the total instructional enterprise. . . but should provide for each trainee an order of flexibility which should enable him to make adjustments to the rapidly changing occupational requirements and thus minimize the retraining which may subsequently be required (Shill and Arnold, 1965).

A second approach to ordering subject matter has been "generalized content categories" and not clusters or families of occupations, per se. Although a more detailed report has been presented in a prior paper at this symposium, attention should be called to this project at the American Institutes for Research. In attempting to discover basic vocational capabilities (skills and knowledges), tasks for

a set of 31 jobs were analyzed. Through test development and testing of about 10,000 pupils, through factor analysis, and by ordering the test results according to male versus female superiority, a rather orderly domain of baisc vocational capabilities was revealed. Components of "Basic Technology" proposed were: 1) general work habits, 2) machines and mechanical principles, 3) electrical principles, 4) structures, 5) chemical and biological principles, 6) numerical operations, 7) verbal communication, and 8) human relations. Such basic technology would be foundational for more specific vocational training at a higher level (Altman, 1965, pp. 7-19).

In a current curriculum project, Stout State University has identified 14 major concepts foundational to more specialized vocational education. These concepts are: 1) energy, 2) processes, 3) material, 4) production, 5) management, 6) marketing, 7) industrial relations, 8) purchasing, 9) research, 10) physical facilities, 11) financing, 12) public interest, 13) transportation, and 14) communication. These concepts are to be further analyzed into subdivisions of a lower order of generality. Teaching-learning materials are being developed to establish a subject area to be known as American Industry (Face, et al., 1965, p. 64).

Yoho has recommended fundamental areas of knowledge that should precede specialized vocational training. These generalized vocational areas are: 1) extractive, 2) distributive, 3) business, 4) manufacturing, 5) service, 6) construction, 7) communication, 8) personal services, and 9) home (Yoho, 1965, p. 35).

Space does not permit a review of all projects now underway, but several should be listed for the benefit of the interested reader. The Vocational Education Summer Study at the Massachusetts Institute of Technology, under the direction of Professor Nathaniel H. Frank, considered the problem of generalized vocational education (Summer, 1965). The junior high school level was considered pivotal. A project at The George Washington University, under the direction of Dr. John T. Dailey, has as its goal the development of materials for teaching basic vocational talents. The Center for Technological Education at the San Francisco State College, under a Ford Foundation grant, is designing school programs around "clusters of content information" rather than clusters of occupations. Under the administration of Dr. William G. Loomis, State Director of Vocational Education in Oregon, a statewide study of vocational education is being made with one of several outcomes being the identification of emerging job clusters. As a part of a project to assess the efficacy of self instructional methods in vocational education, the Battelle Memorial Institute in Columbus, Ohio, will attempt to identify "primary vocational skills," first in trade and industrial education and later in other vocational fields.

NEED FOR A FUNDAMENTAL RATIONALE

In the initial months of study, the staff of the Industrial Arts Curriculum Project (IACP) pondered the central questions--what is industry?--and what is the unique

body of knowledge that represents or is associated with industry? In order to provide adequate answers to these questions, the very nature of the divisions of man's knowledge were investigated to provide clues. The connotations of the term "technology" came under close scrutiny. The relationships of industry to technology were studied. The relationships of technology to other domains of man's knowledge were considered.

An outgrowth of this procedure has been the development of a fundamental rationale for the structuring of man's knowledge of practice. The rationale provides a conceptualization of a body of knowledge that may be studied for general or cultural purposes as well as for specialized (or vocational) purposes. Knowledge structured in this way provides built-in transfer of learning potential.

The remainder of this paper presents this rationale. The import for structuring vocational curricula should become evident.

KNOWLEDGE OF PRACTICE--SIGNIFICANT DOMAIN OF KNOWLEDGE

Into what divisions might man's knowledge be categorized logically? Attempts to classify or categorize the vast body of accumulated and recorded knowledge are difficult, since there is controversy as to the nature of knowledge and because knowledge is always in a state of development. Man's knowledge may be conceptualized and ordered into four domains or classes (E. Maccia, 1965a).

It must be recognized that such classes are interrelated, and the lines of demarcation may not be too clear (See Figure I).

The first domain is formal knowledge. The established disciplines within formal knowledge serve as tools which are used to order all knowledge and, therefore, could be abstracted out as form or arrangement (syntactics). Logic, mathematics, and linquistics are examples of such fundamental disciplines.

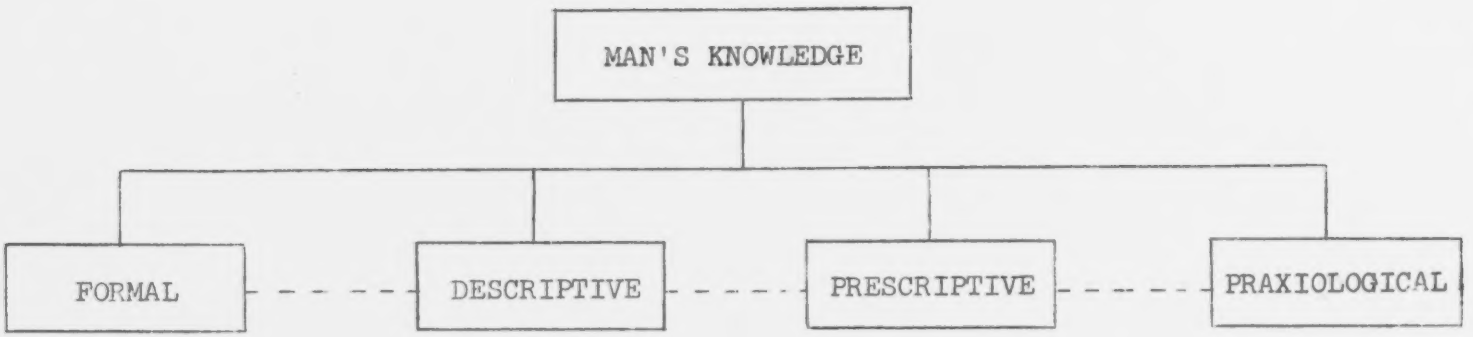
The second domain is descriptive knowledge. The key term in common use that may be used to identify descriptive knowledge would be "sciences." The sciences seek and establish facts about phenomena and events and describe their interrelation. All of the disciplines that comprise the physical sciences, the biological sciences, and the social sciences represent descriptive knowledge.

The third domain of man's knowledge may be termed prescriptive knowledge. Disciplines within the humanities and fine arts seek to provide man with a system (or systems) of values--judgments as to whether phenomena or events ought to be--whether true and/or good and/or beautiful.

The fourth domain of man's knowledge--one which is rarely recognized--is praxiological knowledge. In the secondary school, courses in the practical arts and vocational education are attempts at organization of such knowledge. This domain is represented in higher education by the various professional schools and departments. Among them

Figure 1

THE FOUR DOMAINS OF MAN'S KNOWLEDGE



would be medicine, law, engineering, management, marketing, education, dentistry, dairy technology, pharmacy, and many others. These so-called applied or derived fields of knowledge draw upon the formal, descriptive, and prescriptive domains as necessary but insufficient background for full status in the practicing profession. Practice (or internship), per se, is necessary also for proper training; but, together with formal, descriptive, and prescriptive knowledge, is not sufficient. These disciplines demand a clinical or professional body of subject matter. This body of knowledge is termed theory of practice, knowledge of practice, or praxiology--man's ways of doing which bring about what is valued or what ought to be through action.

In a recent paper, Elizabeth Maccia wrote:

> A practice is a group of human actions which may or may not involve material objects as instruments in such actions. Practices of their very nature have outcomes. Practice theory, therefore, is a set of propositions about practices and their relation to outcomes. If the propositions include some laws, then the practice theory has some degree of adequacy and so is knowledge about practice; i.e., praxiology (E. Maccia, 1965b, p. 14).

The term "praxiology" comes from the Greek 'praxis' meaning to do, or the practice of an art, science, or technical occupation. The suffix 'ology,' connoting a science or branch of knowledge, completes the full meaning: the knowledge of man's practices.

Kotarbinski defines praxiology as "the science of efficient action." He states:

> . . .the tasks of praxiology are to formulate and to prove recommendations concerning what must be done: what it is advisable to do under definite circumstances in order to attain the intended results in the most efficient way.
>
> . . .In our endeavour to set apart praxiological theorems we shall have, first of all, to distinguish the essential theses of that discipline, as opposed to its auxiliary and secondary sentences. Now these essential theses are certain practical directives, that is, directives recommending as appropriate means those which lead to definite results (Kotarbinski, 1962, p. 211).

That praxiology represents more than the sum of the parts (formal, descriptive, and prescriptive knowledge), he continues:

> . . .The essential point is that the practical disciplines cannot remain satisfied with borrowing from strictly theoretical disciplines their theorems or relationships between events, but must themselves search for those relationships on which their own recommendations are to be based (Kotarbinski, 1962, pp. 219-20).

For example, knowledge of practice may be codified that goes beyond the laws and principles, say of physics or chemistry, as they relate to an industrial establishment. In support of this contention, one writer states: "Technologies founded on an application of science may form a scientific system of their own. Electrotechnics and the theory of aerodynamics are examples of <u>systematic technology which can be cultivated in the same way as pure science</u>" (Polanyi, 1964, p. 179).

11

Indeed, there is a wide range of knowledge involved, for example, in industrial technology which has a characteristic logic of its own. Its logic is based on operational principles and rules for which physics and chemistry cannot be substituted.

Tykociner recognizes within his framework of knowledge an area he terms 'pronoetics' (from the Greek meaning foresight). Bodies of knowledge of this kind maintain and improve upon the social order by projecting its needs and devising ways of meeting them. Of pronoetics Tykociner writes, "Its basic sciences are agriculture, medicine, technology (engineering), and national defense. All of these sciences aim to sustain life and provide for the needs of oneself, one's family, the community, the state, the country, and mankind as a whole" (Tykociner, 1964, p. 140).

That such organized bodies of practical knowledge exist is indicated by Phenix:

> Some disciplines are primarily devoted to understanding apart from the service of practical needs. Others are concerned mainly with application. Physics is an example of the former and engineering of the latter. Economics is a purely cognitive discipline, while marketing and insurance are practical or applied disciplines. History comprises pure knowledge; law deals with practical matters. Knowledge in the applied disciplines has structures, just as in the case of the theoretical disciplines. The practitioners of the applied disciplines also form identifiable communities of specialists. Similarly, the practical disciplines owe their existence to the fact that productive ways of organizing knowledge have been discovered. In these cases, however, the productivity is measured by success in dealing with the problems of practice (Phenix, 1964, pp. 50-1).

According to Phenix, ". . .all curriculum content should be drawn from the disciplines. . .that only knowledge contained in the disciplines is appropriate to the curriculum" (Phenix, 1962, p. 57). Since there are practical disciplines, it would follow therefore, by this argument, that the school could include elements of such study in the curriculum.

The case herein made for the recognition of praxiology does not imply any de-emphasis of the formal, descriptive, and prescriptive domains of knowledge. They form, however, only a portion of the base upon which the praxiological studies rest. In addition, the element of practical experience is critical. It must be pointed out that a "knowledge of practice" does not reduce the need for "knowledge" or for "practice." All three ingredients--1) knowledge (traditional knowledge of formal, descriptive, and prescriptive), 2) knowledge of practice (less traditional or less recognized knowledge), and 3) practice--are necessary for a complete educational program.

DEVELOPMENT OF INSTITUTIONALIZED PRACTICE

Man's practices or patterns of action have developed as man himself has developed. As patterns of action have become formalized over the ages, fundamental social institutions have developed. Perhaps the most fundamental of primitive man's normative patterns of behavior was the institution of the family. The religious institution, with its evolving beliefs and practices, was also fundamental to early man.

As society developed, the institution of the family was unable to accommodate all of man's practices.

Patterns relating to economic activity became formalized outside of the family. Relationships developed regarding government, politics, and law as society became more complex. A formalized pattern of education has become more significant throughout the development of man and the consequent development of man's accumulated knowledge.

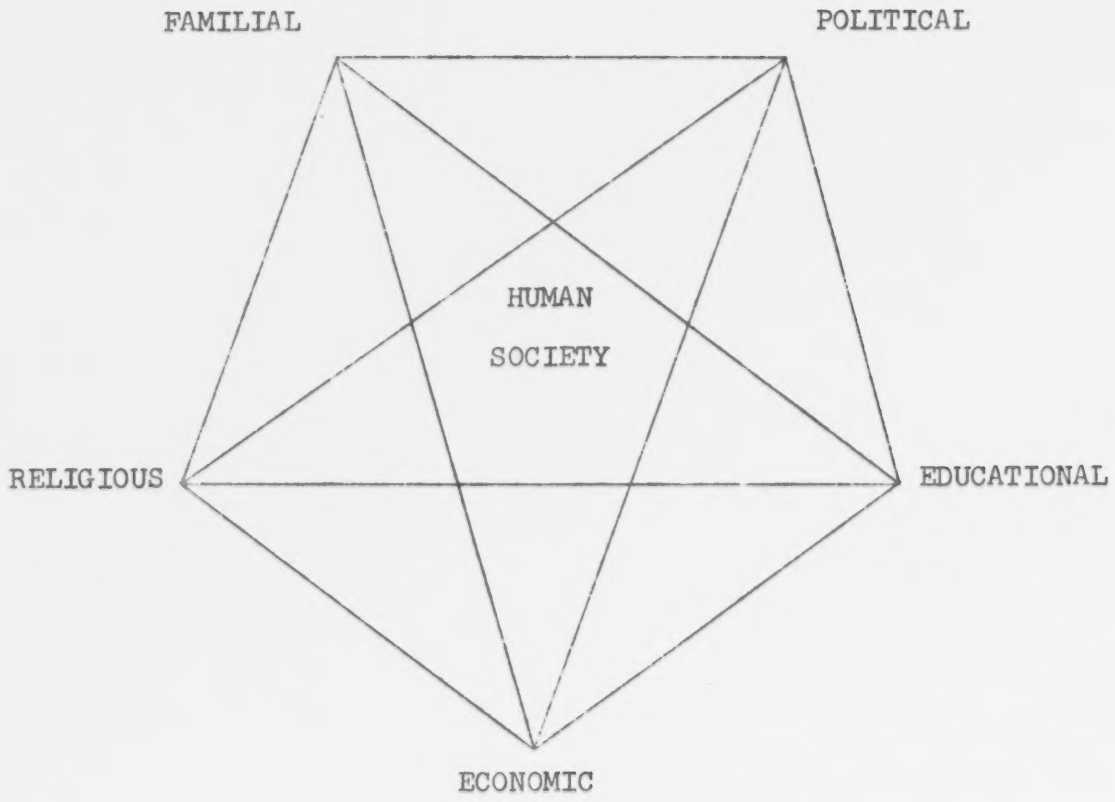
Cuber indicates that sociologists generally agree that the fundamental social institutions of man are 1) familial, 2) religious, 3) economic, 4) political, and 5) educational (Cuber, 1951, p. 433). Berelson and Steiner propose these five with the addition of a sixth, military (Berelson and Steiner, 1964, p. 384); but this institution might be subsumed under the political institution. Assuming these five institutions are fundamental, they may serve as valuable constructs in conceptualizing man's practices (See Figure 2). As in all categorization or classification schemes, these divisions are not precise since there are no sharp lines of demarcation and the functions often overlap. The interrelationships between and among these institutions are many.

VOCATIONAL EDUCATION AND THE ECONOMIC INSTITUTION

The economic institution has been formalized to satisfy man's wants for economic goods. The formal school has developed vocational education curricula which have focused upon training for practices primarily within the

Figure 2

BASIC SOCIAL INSTITUTIONS



economic institution. Areas of vocational education as defined by federal legislation include agriculture, business and office operations, distributive education, home economics, and trade and industrial education. Although there are other interrelationships, only the practices of home economics relate closely to a second institution, the family. Formalized vocational education for practices (occupations) of the political, religious, and educational institutions have been primarily the task of higher education, together with the technical and professional occupations within the economic institution.

Throughout history, formalized training in vocation has occurred at several levels, from the master-apprentice relationship through school vocational education through higher education on a professional level. Law, medicine, and other praxiological disciplines were partially established well before the nineteenth century. The land grant collegiate institution, an American innovation of the nineteenth century, provided impetus to the development of professions of practice in agriculture, the mechanic arts (engineering), and national defense (military training).

At the school level, subjects of a practical type have developed principally since the turn of the century. Generally speaking, however, they have been based upon a limited number of practices of the farm, the home, business, and the custom trades. Selected skills (practices), and selected related information (theory) have shaped the

character of such school offerings. Little or no attempt has been made to conceptualize and formulate the body of knowledge of the practice of man within each field of study. Therefore, subjects of this type have been "practice" oriented together with some supporting "basic" knowledge from the formal, descriptive, and prescriptive domains. Praxiological content, the knowledge of the practice, has been greatly neglected.

Training for many occupations and occupational divisions within the economic institution has not been provided within the traditional framework of reimbursable vocational programs. One has but to study the two-digit occupational divisions listed in the Dictionary of Occupational Titles, Third Edition, Volume II, 1965, to find that many divisions are not represented by programs in vocational education.

In this complex world where a great premium has been placed upon transferable knowledges and skills, vocational education curriculum planners should attempt to rethink the overall divisions of practice (and knowledge of practice) within economic activity. Perhaps from such an analysis, modified or new generalized curricula would evolve.

STRUCTURING PRAXIOLOGY WITHIN THE ECONOMIC INSTITUTION

To the layman, terms such as agriculture, business, and industry, taken collectively, grossly describe the field of man's economic activity. For purposes of more precise

analysis, however, the elements of the economic institution must be more carefully conceptualized.

Figure 3 presents an attempt to categorize the elements of the economic institution. In many respects this classification is similar to the Standard Industrial Classification used by the U.S. Government in classifying establishments by type of activity (Bureau of the Budget, 1957).

Each of the elements of the economic institution has its unique body of knowledge of practice associated with it. It is the task of the curriculum specialist to conceptualize the structure of such knowledge and translate it into educational programs.

Figure 4 presents the curriculum specialist with a paradigm that may aid in the understanding of both the total economic system and the unique characteristics of the elements of it. As a general model of the economic institution, it tells the story from initiation of activity through the satisfaction of human wants for economic goods. In addition, it also serves as a model for any element of the institution. This paradigm assists in conceptualizing the unique knowledge of practice and at the same time provides insight into the input, process, output system.

The subject matter of industrial arts is drawn from the structured body of knowledge known as industrial praxiology. The Industrial Arts Curriculum Project (IACP) has defined industry as that element of the economic institution which produces manufactured and constructed goods. Figure 5 indicates the relationship between the elements of material production within the economic institution. Figures 6 and 7 present the major dimensions of the knowledge of practice of industry.

Figure 3

ELEMENTS OF THE ECONOMIC INSTITUTION

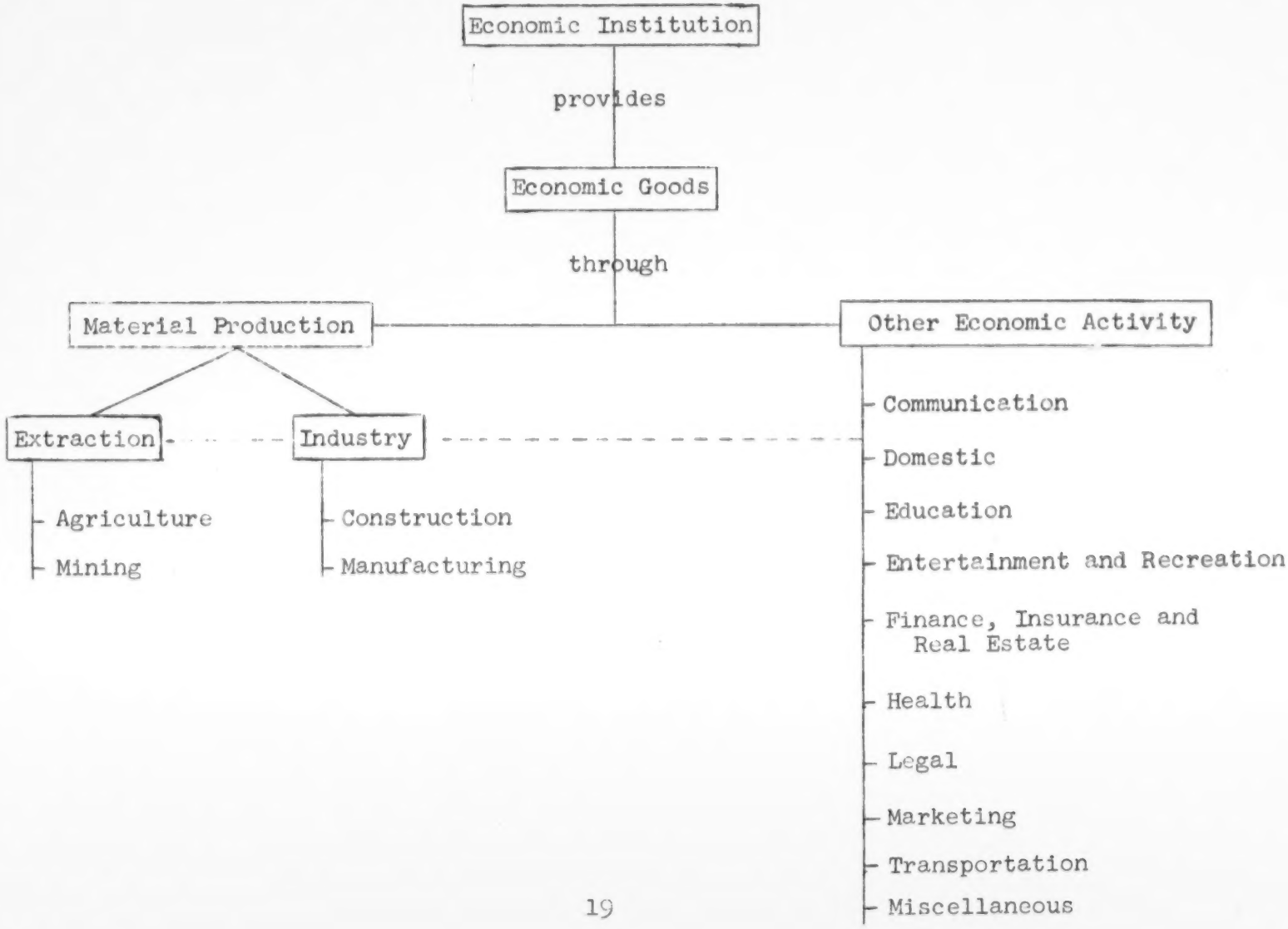


Figure 4

A PARADIGM OF THE ECONOMIC INSTITUTION

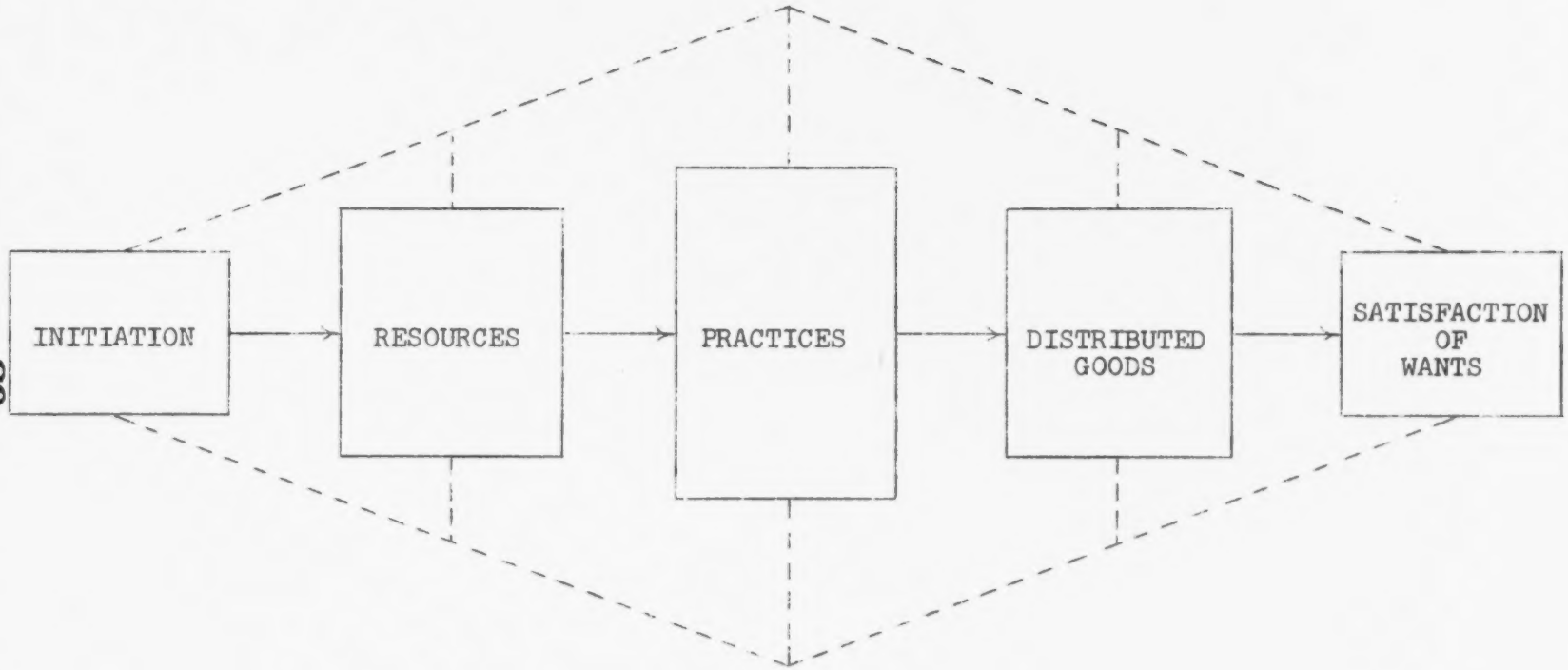


Figure 5

THE MATERIAL PRODUCTION CONTINUUM

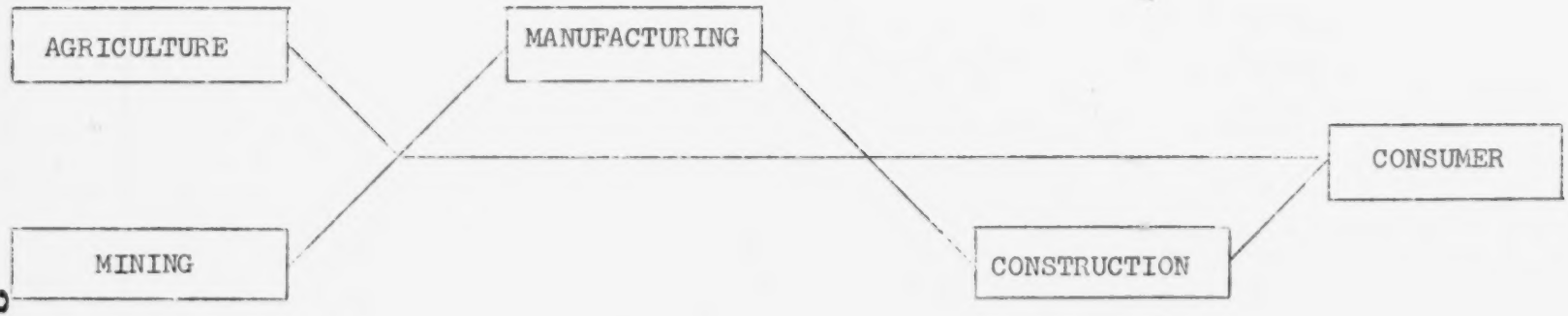


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Figure 6

FIRST ORDER ARRAY OF INDUSTRIAL PRAXIOLOGY

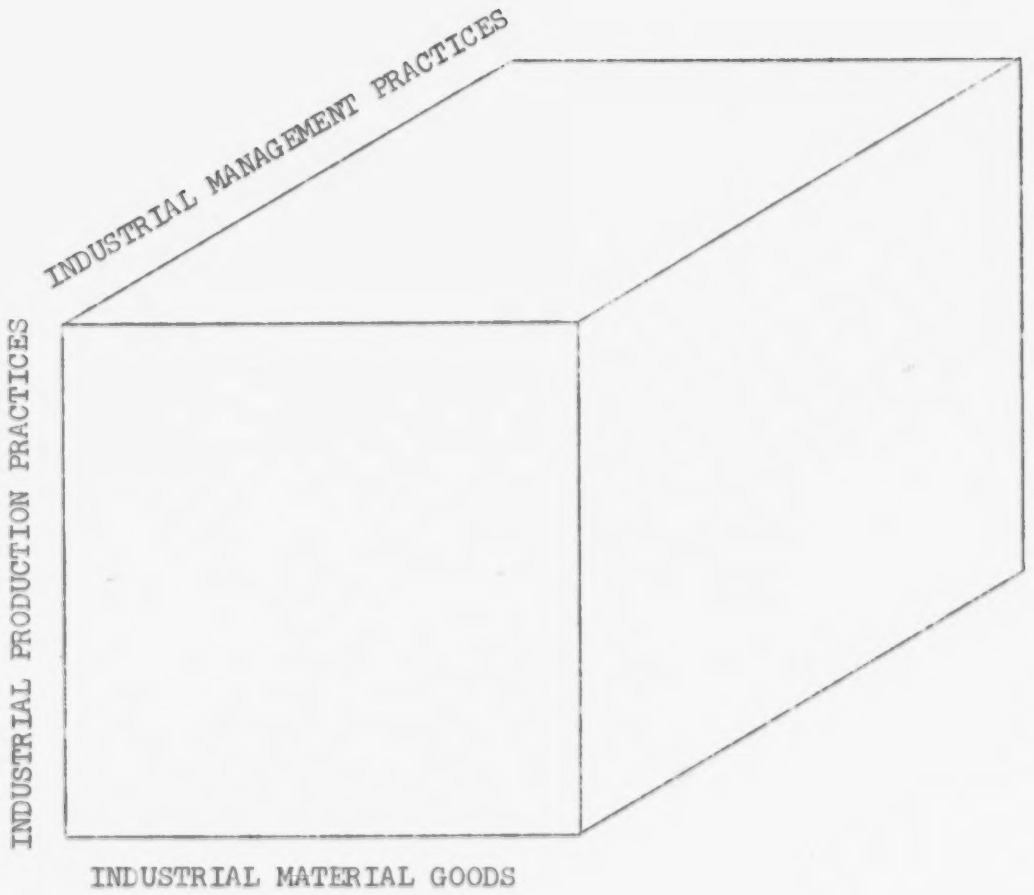
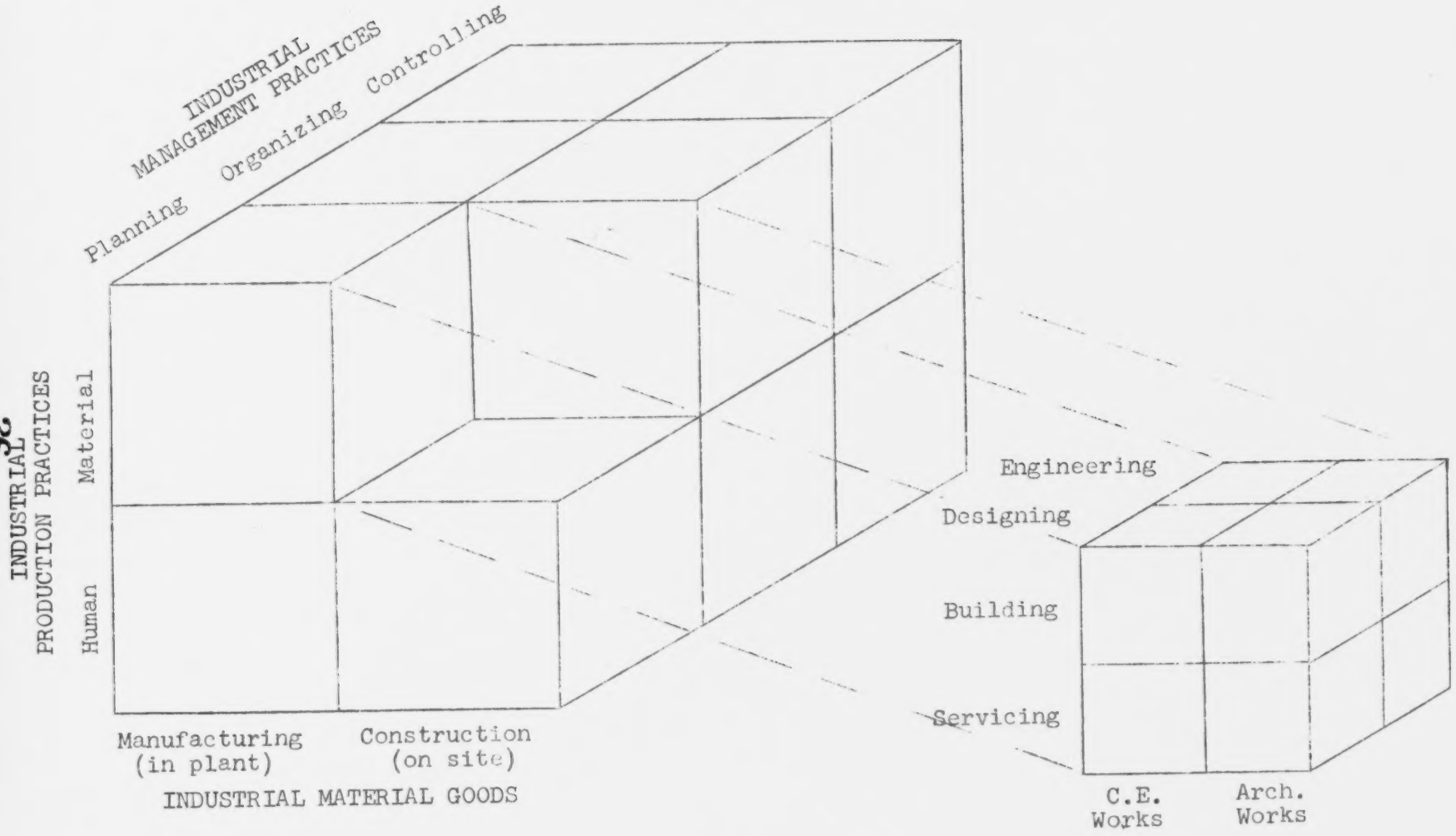


Figure 7

SECOND AND SAMPLE THIRD ORDER ARRAY
OF INDUSTRIAL PRAXIOLOGY



These in turn will be further analyzed and structured through lower levels of generality during the first phase of the project.

CONCLUDING STATEMENT

Each year there are nearly a million high school dropouts and more than a million non-college-bound high school graduates. Approximately 50 percent of all who enter college drop out because of lack of success or interest.

> As a group these represent 75 to 80 percent of all our youth, and the educational preparation and occupational well-being of this group will in large measure determine the course of this nation in the difficult years ahead. As they leave school, they are ambitious, opportunity-seeking, and still idealistic. In the world of work, however, they are likely to be under-employed, if they find employment at all (Venn, 1964, p. 23).

What do they have in their background that will provide them with the necessary knowledges and skills to contribute to the growth of the economy and maintenance of stable employment patterns? In today's rapidly changing world of work, the key saleable skills are flexibility and adaptability. A secondary school program based entirely on the formal, descriptive, and prescriptive disciplines will not provide the necessary knowledges and skills for entry into the labor market. On the other hand, a school program geared to isolated occupational practices which may be obsolete within a few years will not meet the demand. This point

is amplified in the "Rockefeller Report on Education":

> In this day of technologies that become antiquated overnight, it is hazardous to predict a favorable future for any narrow occupational category. There will be economic advantage to the individual in acquiring the kind of fundamental training that will enable him to move back and forth over several occupational categories. Individuals so trained will find a market for their talents under most circumstances. Individuals more narrowly trained will be at the mercy of circumstances (Gardner, et al., 1958, p. 10).

A school program which provides a study of the fundamental principles of practice (praxiology) together with selected practice and a broad theoretical base may meet the challenge of the future. Such a program will have built-in transfer of learning features which provide the flexibility so definitely needed for occupational, psychological, social, and economic adjustment.

A majority of students, especially the large group that does not enter or satisfactorily complete college, will have the need for specialized education in basic fields of practical knowledge. A major source of difficulty, however, has been the lack of viable divisions of knowledge of practice at the school level, adequately conceptualized knowledge within each division, and the teaching-learning support materials.

The task seems evident and clear. Attempts must be made to determine the basic and significant knowledge of man's practices. This knowledge must be structured to permit effective and efficient transmission to pupils at the

school level. Special attention must be given to the problem of imminent obsolescence. The disciplines of practice at the collegiate level are major but not all inclusive sources of such school content. Other practices of man, not well codified or contained in collegiate offerings, provide fruitful sources.

One final significant point must be made. When the body of praxiological knowledge is conceptualized into a meaningful structure for pedagogical purposes, it can serve many educational programs meeting special needs at various school levels. Differential subject matter would be drawn from the body of praxiological knowledge for: 1) pupils receiving a common general education base, 2) pupils planning degree or non-degree post-high school education, 3) pupils seeking rather specialized occupational training, 4) pupils in the uncommitted "general" curriculum who need a generalized occupational education, and 5) atypical pupils requiring modified educational programs.

With the recognition of the role that praxiology has to play in the education of all young people, and especially of those not entering or succeeding in higher education, a more effective educational pattern at the school level can be designed.

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